COATED SUBSTRATE

The invention relates to a method for coating a substrate. The invention also relates to a coated substrate thus obtainable, and to the use thereof in a post-forming process.

A method for coating a substrate is known from US-3,730,828, which publication describes that a post-formable substrate is coated with a decorative barrier sheet consisting of ordinary α-cellulose wood fibre impregnated with a fully cured, unplasticized melamine-formaldehyde resin with a narrow range for the mole ratio between the formaldehyde and the melamine. A laminate is prepared by assembling various layers of kraft paper and a top, barrier, sheet with the unplasticized melamine-formaldehyde resin. All these carrier layers are formed into a laminate by placing the stacked layers in a laminating press under high pressure and at high temperatures during a certain amount of time. A disadvantage of the laminates thus obtained is that they cannot be bent into complex shapes along two (or more) mutually intersecting axes without breaking and/or cracking.

In WO 99/13000, a laminar prepreg is described which prepreg comprises one or more layers of a laminar carrier that is impregnated with an as yet uncured resin. The carrier is a laminar porous polymer. The laminar porous polymer may be a non-woven laminar polymer, a laminar open polymer foam or a microporous membrane. The laminar porous polymer is impregnated with the resin upon which drying is necessary at a temperature between 100 and 160 °C. The so obtained carrier is stacked after drying. The prepreg can subsequently be processed into a shaped final product by first deforming the prepreg and then curing the shaped intermediate product at elevated temperature or by combining the deformation and the curing step in one step. A disadvantage of the prepreg according to WO 99/13000 is that the laminar prepreg comprises at least two components that first must be obtained in separate steps: a laminar porous polymer and an (at the prepreg stage) uncured resin.

In WO00/53666 a prepreg is described that contains one or more layers of a porous carrier sheet, which porous carrier sheet has been impregnated with an as yet uncured resin, the carrier containing a meltable polymer mixed with cellulose or regenerated cellulose or mixtures there from. In WO 00/53667 a prepreg is described that contains one or more layers of a porous carrier sheet, which porous carrier sheet has been impregnated with an as yet uncured resin, the carrier being a

porous carrier on the basis of wholly or partly regenerated cellulose. In WO 00/53688 a prepreg is described that contains one or more layers of a porous carrier sheet, which porous carrier sheet contains at least one fibrous cellulose ester. A disadvantage of these systems that are based on a porous polymer as a carrier and an (at the prepreg stage) uncured resin is that at least two components are necessary in the initial stages of the prepreg stage.

It is an object of the invention to overcome the above-mentioned disadvantages and to make available a method to coat a substrate with a melamine-formaldehyde resin which is less complicated than the methods in the prior art and still results in a coated substrate with good mechanical properties. Good mechanical properties are for example required when the coated substrate is afterwards subjected to post-forming.

The object is reached by a method that comprises the following steps:

a) Applying a layer comprising a melamine-formaldehyde resin A to a substrate, whereby a coated substrate is formed;
b) Optionally treating the coated substrate with IR- or NIR- radiation;
c) Optionally applying an ink, dye solution or pigment dispersion to the coated substrate;
d) Optionally applying a layer comprising a melamine-formaldehyde resin B to the coated substrate from step b) or c);
e) Placing the coated substrate in a press;
f) Optionally heating the coated substrate in the press for a certain amount of time;
g) Increasing the pressure in the press and keeping the coated substrate under pressure for a certain amount of time.

In the method according to the invention, it is not necessary to impregnate and dry a carrier such as a paper or other cellulose-based material or a porous polymer. Indeed, in an embodiment of the invention that the layer comprising melamine-formaldehyde resin A does not comprise such a carrier. Similarly, it is preferred that the optional layer comprising melamine-formaldehyde resin B does not comprise a carrier. In such cases the space and apparatus necessary for the process of coating a substrate can be reduced compared to the prior art where impregnating and drying of a carrier are done. Another advantage of the method according to the invention is that separate stacking of the various layers is not necessary anymore. A

further advantage of the method according to the present invention is that the coating is applied directly onto the substrate that needs to be coated for further use, as for example worktops cupboards and fronts of kitchen cupboards. In this method a separate "prepreg stage" is absent.

If the layer(s) on the coated substrate do not comprise a carrier, it is a further advantage of the method according to the invention that the coated substrate so obtainable can be subjected to a post-forming step in which it is bent along two or more axes; such a post-forming step is also called 3D-forming. Moreover, the preferred absence of a carrier reduces the amount of waste as generated during the preparation of the coated substrate.

In step a) of the method according to the invention, a layer is applied to a substrate, whereby the layer comprises a melamine-formaldehyde resin A. As a result of the application of the layer, a coated substrate is formed. The melamine-formaldehyde resin A is understood to be a resin with as main building blocks melamine and formaldehyde. The melamine-formaldehyde resin A can additionally contain other building blocks, for example urea; flexibilizers as for example diethylene glycol and sugars; and other compounds as known to the skilled person, such as a catalyst. Furthermore, formaldehyde may according to the invention be partly or wholly replaced by another suitable compound; examples of such a compound are alkanol hemacetals such as methylglyoxylate methanol hemiacetal (GMHA) and other hemiacetals as discosed on page 3 of WO 03/101973 A2. The melamine-formaldehyde resin A can comprise or even consist essentially of a resin in powder form (melamine-formaldehyde resin C), in dispersion form (melamine-formaldehyde resin D), in liquid form (melamine-formaldehyde resin E), or any suitable combination of these. In a preferred embodiment, the melamine-formaldehyde resin A comprises at least 40, 50, 60, 70, or even 80, 90 or essentially 100 wt.% of powderous melamine-formaldehyde resin C and/or melamine-formaldehyde resin dispersion D. This has the advantage that the risk that the resin will migrate into the substrate is reduced. Preferably, no carrier is used; as less or even no drying of an impregnated carrier at increased temperatures is necessary in the present invention the method is advantageous from an economical and ecological point of view. The weight ratio between powderous melamine-formaldehyde resin C and melamine-formaldehyde resin dispersion D - as expressed in weight percentages relative to each other - may vary between a wide range, for example between 1%:99% and 99%:1%, more preferably between 10%:90% and 90%:10%, between 25%:75% and 75%:25%, or between 40%:60% and 60%:40%.

More preferably, the melamine-formaldehyde resin A consists essentially of powderous melamine-formaldehyde resin C. This has the advantage that a pattern as brought on via an ink, dye solution of pigment dispersion - as may be done in optional step c) to be discussed hereafter - will remain intact to the greatest possible extent. In this preferred embodiment of the method according to the invention, a powderous melamine-formaldehyde resin C is applied onto the surface of the substrate so as to form a layer. With powder is here and hereinafter meant a solid consisting of small particles generally with a particle size smaller than 250 μm, preferably below 100 μm. With very large particles an even distribution over the surface of the substrate is difficult, further the resolution of an applied pattern that is formed by the ink, dye solution or pigment dispersion in optional step c) is worse than when smaller particles are used. The thickness of the layer is not particularly critical and can be chosen between wide ranges, for example between 20 and 500 μm. A preferred layer has a thickness between 50 and 250 μm. A balance should be found between a thick layer that is advantageous for hiding imperfections in the substrate surface, and a thin layer that is more advantageous for post-forming. It is known to the man skilled in the art how powders can be obtained from melamine-formaldehyde resins. Reference can for example be made to “Kunststoff Handbuch, 10-Duroplaste” by W. Becker, D. Braun, 1988 Carl Hanser Verlag; more specifically to the chapter “Melaminharze”, page 41 and further. The powderous melamine-formaldehyde resin C that may be used in step a) should have a glass transition temperature (T_g) high enough to be stable at room temperature as a powder for an extended period of time. In case the T_g is not high enough the resin particles will coagulate and the powder will lose its form and stability. Suitable values for the T_g are at least 30°C, preferably 40°C, with more preference between 60 and 90°C. The T_g should be below the temperature at which steps f) and/or g) in the method are performed; as when the T_g is higher than the temperature in step f) the resin will not melt and thus it will not flow. Generally the T_g should therefore be below 140°C, preferably lower than 120°C.

The melamine-formaldehyde resin A may optionally comprise a melamine-formaldehyde resin dispersion D. Within the context of the present invention, a melamine-formaldehyde resin dispersion D is understood to mean a system where a liquid such as for example water or an alcohol is the continuous phase, and whereby the continuous phase comprises small non-dissolved particles comprising a melamine-formaldehyde resin in uncured, partially cured or fully cured state. The preparation of such dispersions is described in a.o. WO 97/07152, EP 1 099 726 A2 and US

6,245,853 B1. The said particles may be themselves liquid or solid. Although the size of the dispersed particles may vary within wide limits, it is preferred that the weight-averaged size lies between 0.1 μm and 100 μm, more preferably between 0.5 and 75 μm, between 1 and 50 μm, between 1.5 and 25 μm, or even between 1.75 μm and 15 μm or between 2 μm and 10 or 5 μm. Such dispersions are as such known; as is also known, it is often helpful or even necessary to use a dispersant / protective colloid in order to achieve a stable dispersion. Within the context of the present invention, the term 'stable' can have two meanings: either that the dispersed particles do not separate out, coagulate or settle for at least 30 minutes (or even at least 1 hour or preferably at least 24 hours) after dispersion preparation; or that the dispersed particles can be easily re-dispersed through agitation in case they have separated out, coagulated or settled.

As a general recommendation, it is noted that it is preferably avoided to have a degree of condensation in the dispersed particles that is so high that it becomes impossible to let these particles undergo a curing in the method according to the invention in such a fashion that the particles fuse with other particles. Similarly, it is noted that it is preferably avoided to have a degree of curing in the dispersed particles that is so high that it becomes impossible to let these particles undergo a further curing in the method according to the invention in such a fashion that the particles fuse with other particles.

As is disclosed in the cited disclosures, various suitable dispersant for use in the preparation of a stable melamine-formaldehyde resin dispersion D have been identified. In general, dispersants are often derived from long-chained polymers in the solid or liquid state, whereby the said polymers are converted into a form in which they are soluble in the liquid that is the continuous phase in the dispersion; such conversions are known and may comprise a treatment at elevated temperature in the said liquid, possibly aided by other compounds such as acids or bases. It may hereby be beneficial if the said dispersant, once prepared in liquid form, has a pH below 9, more preferable below 8 or even 7; this can have the advantage that the dispersant does not - in the later to be discussed step g) - slow the resin condensation and/or curing reactions down, and may even accelerate them advantageously.

The known suitable dispersants, however, have as disadvantage that the solids content of the dispersion is rather low; in WO 97/07521, for example, the solids content is about 25%. Solids content is defined as the cumulated weight percentage of all compounds except water, as calculated from the raw materials as

used in preparation. It was found, surprisingly, that dispersants containing styrene maleic anhydride copolymers or compounds derived therefrom are particularly suitable. More in particular, aqueous solutions of styrene maleic anhydride copolymers having a molecular weight higher than 1,500 are preferred. The invention thus also relates to a dispersion of liquid or solid melamine-formaldehyde resin particles in a liquid, preferably water or an alcohol, whereby the dispersion contains a dispersant, whereby the said dispersant comprises a styrene maleic anhydride copolymer, said copolymer preferably having been treated so as to render it soluble in the continuous phase of the dispersion. Within the context of the present invention, the term styrene maleic anhydride copolymer can refer to the copolymer as such or to the copolymer after it has been treated so as to render it soluble in the continuous phase of the dispersion. An advantage of using the said copolymers is that it is possible to obtain a stable melamine-formaldehyde resin dispersion D having a high solids content, i.e. higher than 30% and preferably between 35% and 65%. It is preferred that the weight-averaged molecular weight (Mw) of the styrene maleic anhydride copolymers is higher than 1,500, 3000, 10,000, 50,000 or even 100,000; preferably, the said molecular weight Mw is at most 3,000,000 or 2,000,000, more preferably at most 1,000,000. The molar ratio of styrene to maleic anhydride in the copolymer may according to the invention vary between wide limits, preferably between 1:0.1 and 1:1, more preferably between 1:0.5 and 1:1. As is known, aqueous solutions of styrene maleic anhydride copolymers may be prepared by a treatment of the copolymer in water with a base at an elevated temperature. An example of a suitable styrene maleic anhydride copolymer is Scripset® 520 (supplier: Hercules; molecular weight about 350,000, molar styrene to maleic anhydride ratio 1:1). In a separate aspect of the invention, the styrene maleic anhydride copolymer may also be used to create a stable dispersion of melamine particles in a liquid such as water or an alcohol.

The dispersant may be added to the melamine-formaldehyde / liquid system prior to, during or subsequent to the melamine-formaldehyde resin- and/or particle forming reactions. The amount to be added may vary within wide limits, depending a.o. on the precise nature of the dispersant, the liquid, and also depending on the desired particle size to be achieved. Preferably, the melamine-formaldehyde dispersion D contains between 0.01 wt.% and 10 wt.% dispersant, more preferably between 0.05 wt.% and 7.5 wt.%, between 0.2 wt.% and 5 wt.% or between 1 wt.% and 3 wt.%.

The melamine-formaldehyde resin A may optionally comprise a liquid

melamine-formaldehyde resin E. The preparation of a liquid melamine-formaldeyde resin E is known to the person skilled in the art, e.g. from the abovementioned reference "Kunststoff Handbuch, 10-Duroplaste" ("Melaminharze" chapter). In a preferred embodiment, melamine-formaldehyde resin A comprises both a liquid melamine-formaldehyde resin E and a melamine-formaldehyde resin dispersion D. This has the advantage that, compared to a coated substrate wherein melamine-formaldehyde resin A contains the same amount - expressed in solids content - of only a liquid melamine-formaldehyde resin E, the gloss of the coated substrate after curing (i.e. after completion of step g), to be discussed below) is higher. The weight ratio between liquid melamine-formaldehyde resin E and melamine-formaldehyde resin dispersion D - as expressed in weight percentages relative to each other - may vary between a wide range, for example between 1%:99% and 99%:1%, more preferably between 10%:90% and 90%:10%, between 25%:75% and 75%:25%, or between 40%:60% and 60%:40%. In particular, the combinations lying between 98%:2% and 85%:15% of liquid melamine-formaldehyde resin E and melamine-formaldehyde resin dispersion D are preferred for gloss enhancement. The said gloss enhancement is observed irrespective of whether the layer comprising melamine-formaldehyde resin A as applied to the substrate comprises a carrier such as a décor paper or not. In one embodiment of this aspect of the invention, step d) is not executed in order to fully benefit from the gloss enhancement.

It may be that where a melamine-formaldehyde resin A contains both a liquid melamine-formaldehyde resin E and a melamine-formaldehyde resin dispersion D, the resin A will have a paste-like form. This is advantageous in that it may be applied in an easy and controllable fashion.

The melamine-formaldehyde resin A is preferably able to form a non-porous layer after curing in step g) so as to prevent diffraction of light by included components as for example water or air. Diffraction would lead to a "blurred" pattern. This requirement can advantageously be reached by a formaldehyde-melamine ratio in the resin A between 1 and 3 (on mol basis). Optionally the melamine-formaldehyde resin A can be partially crosslinked before it is applied onto the substrate. Depending on the precise composition of the melamine-formaldehyde resin A, the rate of pre-crosslinking influences the ability to flow. When the pre-crosslinking has proceeded too far, the resin A will not flow sufficiently and it will be impossible to remove all included components such as for example air by pressing. The man skilled in the art can easily determine the desired rate of pre-crosslinking.

Another method to increase the possibility that a non-porous layer is formed is by chosing melamine-formaldehyde resin A such that it comprises a mixture of powderous melamine-formaldehyde resin C and melamine-formaldehyde resin dispersion D, as indicated above.

The melamine-formaldehyde resin A can additionally contain a colour-inducing substance such as a pigment. In that case the coating that is finally obtained typically has a more or less uniform colour, with no special recognizable pattern. In case that such a uniform coloured layer is required the optional step c) could be left out but it may still be desirable to add in step d) a transparent topcoat layer on top of layer A to obtain a better appearance and durability. When a décor pattern in the coating is desired steps c) and d) are required.

If the melamine-formaldehyde resin A comprises or even consists essentially of the powderous melamine-formaldehyde resin C, the said powderous melamine-formaldehyde resin C should preferably display such a combination of properties that it can form a porous layer after the melting in optional step b). When the resin particles melt, they flow towards each other. Depending on the circumstances during the flow phase, and given enough time, the molten particles will eventually touch each other completely, thereby eventually giving rise to a non-porous layer. However for the optional step c) it is preferred or even necessary to have a layer that is still porous to some level; this has the advantage that the pattern as applied via an ink, dye solution of pigment dispersion will remain intact to a greater extend during the later steps of the method according to the invention. To keep the layer porous, the temperature during the flow-phase shouldn't be too high when the time for the flow phase is moderate. When the time available for flowing is only short, the temperature should be higher. Therefore a balance should be found between these parameters that determine the amount of flow. The man skilled in the art can easily determine the suitable conditions by routine experimentation.

The kind of substrate depends on the final use of the coated substrate and can be for example wood or wood-based material, paper, metal, glass or plastic. Examples of wood-based materials are MDF (Medium Density Fibreboard) or HDF (High Density Fibreboard), OSB (oriented strand board), particle board, plywood. The coated substrates can be used in a large number of applications, for example serving trays, washing-up basins, crockery, doors, kitchen worktops, furniture and wall panels, kitchen cupboards, window frames, laminated flooring.

Prior to executing step b) it may, depending on the nature of the melamine-formaldehyde resin A and on the demands as placed on the coated substrate, be useful, desirable or even necessary to implement a drying step a1). Such a drying step as such is known may be executed according to the guidelines available to the skilled person.

In optional step b) of the method according to the invention the applied resin is being treated by infrared (IR-) or near-infrared (NIR-)radiation. Radiation within the near-infrared range refers to radiation with a wavelength of between 0.8 μm and 1.5 μm. It is especially preferred to implement step b) if the melamine-formaldehyde resin A comprises or even consists essentially of powderous melamine-formaldehyde resin C; this has the advantage that the layer becomes more coherent. The type of infrared radiation can in principle be chosen freely; it is preferred to use regular IR-radiation for thinner layers, for example up to 5 μm thickness, while NIR is preferably used for thicker layers for example up to 0.5 mm to ensure a favourable temperature profile across the layer thickness. The duration of the radiation depends on the intensity of the radiation and the characteristics of the resin to be treated. If the melamine-formaldehyde resin A comprises or even consists essentially of powderous melamine-formaldehyde resin C, and in particular if optional step c) is applied, the duration and intensity of the radiation should be such that a coherent layer is obtained, that still has a maximum porosity. This can easily be determined by routine experimentation by the man skilled in the art.

In optional step c) a décor pattern is applied to the coated substrate. The coloured material for forming such a pattern can be an ink, or a dye solution in water, solvent or in a polymer, or a pigment dispersion in water, solvent or in a polymer. The coloured material can be a solid or a liquid and can be applied by any kind of imaging technique, such as off-set and roller printing, ink-jet printing, heat-transfer printing, toner printing etc as described in “Handbook of Imaging Materials” (Arthur S. Diamond ed., Marcel Dekker, 1991).

In optional step d) a layer comprising a melamine-formaldehyde resin B is applied to the coated substrate obtained after step a), b) or c). The melamine-formaldehyde resin B can be in the form of a liquid, a dispersion, a powder, or any combination of these. In a preferred embodiment, melamine-formaldehyde resin B is essentially in powderous form; this has the advantage that the risk is reduced that the resin will penetrate into the underlying layer(s) of the coated substrate. The nature of the melamine-formaldehyde resin B can vary, depending on the required properties of

the final coating. Preferably the resin B is in powderous form with a T_g in the same ranges as indicated for powderous melamine-formaldehyde resin C; it preferably has a good flow at the temperature in subsequent steps f) and g) and cures into a transparent and scratch-resistant topcoat so as to make any underlying layer or pattern visible, while also giving an excellent adhesion with the underlying layer by co-reaction in the subsequent step or steps f) and g). In order to protect the underlying layer(s) from environmental influences and degradation, stabilizers for example Hindered Amine Light Stabilizers (HALS), and UV absorbers can be added to melamine-formaldehyde resin B. In addition, to ensure a better scratch resistance inorganic fillers for example clay, silica and corundum can be added to the resin. Preferably, for the purpose of maintaining the optical transparency, filler particles of less than 300 nanometer are used.

Prior to executing step e) and if one of the optional steps b), c) and d) have been implemented it may, depending on the nature of the melamine-formaldehyde resin A and on the demands as placed on the coated substrate, be useful, desirable or even necessary to implement a drying step d'). Such a drying step as such is known may be executed according to the guidelines available to the skilled person.

Subsequent to step a) and optionally steps b), c), d), and d'), the coated substrate is, in step e), placed in a press. Presses are as such known to the skilled person; an example of a known press is a laminating press. Should the step preceding to step e) of the method according to the invention be already executed in a press, then step e) may be interpreted as simply leaving the coated substrate in the press.

Once the coated substrate has been placed in a press, it is - in step f) - optionally heated in the press for a certain amount of time. The absolute duration is not critical. Time and temperature are interdependent, it means that the result obtained counts but that the result can be obtained either by a high temperature and a relatively short time or by a somewhat lower temperature and a longer time. For example the time can vary between 1 and 3 minutes and the temperature can than vary between 100 and 140°C. The balance between time and temperature should be chosen so as to result in a level of cure to give acceptable properties regarding the gloss and Kiton test for laminates.

Advantageously the coated substrate is pre-cured in step f) before applying pressure in subsequent step g). This pre-curing is done to reduce or even

prevent flow and absorption of the resin into the substrate or to the side of it under the influence of pressure, which would negatively influence the mechanical and/or optical characteristics of the coated substrate. For example, the risk of an image - if brought onto the coated substrate in optional step c) - getting blurred is reduced by the pre-curing according to the invention. For this purpose, the press can for example been pre-heated before the coated substrate is fed to it. Alternatively the coated substrate can be pre-treated in a separate step so as to result in a partially cured coating, for example by using IR or NIR radiation. Both alternatives result in a better resolution of any pattern when a pigment, ink or dye is used in step c). It has also been found that the pre-heating or pre-treating results in a better topcoat.

In step g) the coated substrate is subjected to increased pressure and kept under pressure for a certain amount of time. The object of step g) is to achieve an at least partial but preferably full curing of the layer(s) in the coated substrate. The conditions of pressure, time and temperature are as generally used for curing in the field of melamine-containing laminates.

The invention also relates to the melamine-formaldehyde coated substrate that is obtainable with the method according to the invention. It has good mechanical properties. Depending on its further use, requirements need to be met in view of for example scratch resistance, flexibility, durability, chemical resistance, abrasion resistance, cold check (that means the crack resistance at a sharp temperature change). Depending on its final use some of the above-mentioned properties are more important than others. Also depending on its further use of the coated substrate, requirements need sometimes to be met in regard of its appearance.

The melamine-formaldehyde coated substrate that is obtainable according to the invention shows improved adhesion between the applied layer(s) and the substrate compared to the prior art laminates in which first a prepreg is made where after the prepreg is pressed onto the substrate.

The invention further relates to the use of the coated substrate that is obtainable according to the method of the invention in a post-forming process; this has the advantage that the risk of sustaining structural damage to the coated substrate - and in particular to its layer(s) - is greatly reduced or even eliminated.

The invention also relates to the use of a melamine-formaldehyde resin with a molar formaldehyde to melamine ratio between 1 and 3 in a method according to the invention.

The invention is further elucidated by means of the following example, without being limited thereto.

Example 1

A powderous melamine-formaldehyde resin C was obtained by spray-drying of a 65% solid content melamine-formaldehyde resin, formed from a commercially available resin (Madurit MW 909) having a molar formaldehyde to melamine ratio of 1.7, and catalysed with 3 wt.% ammonium sulphate. 0.018 grams of the spray-dried resin C was applied to a wood panel; the coated surface area was 2 cm by 6 cm. Thus the melamine-formaldehyde resin A consisted for 100% of powderous melamine-formaldehyde resin C. The panel was pressed with a pressure of 69 bar during 4 minutes; the temperature during pressing was 140°C. As a result, the coated substrate had a high gloss and hard surface, comparable to a known laminate as produced through an impregnated carrier.

Example 2

A 65% solids content resin was made from a commercially available aqueous melamine-formaldehyde resin (Madurit MW 909) and was catalysed with 3 wt.% ammonium sulphate so as to obtain a liquid melamine-formaldehyde resin E. The melamine-formaldehyde resin A consisted in this example for 100% of the said liquid melamine-formaldehyde resin E. The resin A was applied to an MDF panel; the layer thickness was 120μm; the coated surface area was 10 cm by 15 cm. The panel was pressed with a pressure of 26 bar during 4 minutes; the temperature during pressing was 140°C. As a result, the coated substrate had a high-gloss and hard surface.

Example 3

Preparation of a melamine-formaldehyde resin dispersion D

Preparation of a dispersant: an aqueous solution of a styrene maleic anhydride copolymer (Scripset® 520, supplier: Hercules) was prepared. 61 gram of Scripset 520 was charged slowly to 455 grams of stirred water. After a reasonable lump-free slurry was achieved, 50 grams of 25 (wt.%) NaOH solution in water was added. An exothermal reaction to about 40°C occured. The batch was then heated to 82°C under stirring and held for 45 minutes. The pH was adjusted (upwards only) to 6.5 if needed.

Synthesis of an MF dispersion: the pH of 406 grams of a 38.5 wt.% aqueous solution of formaldehyde, to which 199 grams of water was added, was adjusted to 9.0 with 2 M NaOH. 394 grams of melamine were added; the mixture was then heated to reflux. After the melamine dissolved and a clear solution was obtained, the mixture was cooled down to 82°C. Then 145 grams of the dispersant solution as prepared above was added, and the pH of the mixture was adjusted to 7 with HNO_3, while at the same time the solution is vigorously stirred. After about 15 minutes a sharp turning point - i.e. a whitening - of the solution is seen. The solution turns from milky to a clear white turbid dispersion. The condensation reaction of the dispersion is continued for an additional 9 minutes after the turning point and then cooled down to 20°C. One minute after starting cooling down the pH of the dispersion is adjusted to pH=8.6 with 5M NaOH. About 8 grams is needed. While stirring the solution is cooled down to 20°C and stored in plastic bottle. The resulting dispersion had a solids content of 55% and a molar formaldehyde to melamine ratio of 1.65. The dispersion was stable for several days.

Preparation of a coated substrate

The synthesized resin dispersion D was applied to a beech veneer by means of a small doctor roll. Thus the melamine-formaldehyde resin A consisted in this example for 100% of resin dispersion D. After applying the wet dispersion the coating looks white. After drying at room temperature the coating turned into a white surface. This dried coated substrate is pressed at 150°C for 3 minutes at 30 bar in a press. After pressing a substrate having a clear transparent coating was obtained.

Example 4

A melamine-formaldehyde resin A comprising both a liquid melamine-formaldehyde resin E and a melamine-formaldehyde dispersion D was prepared by combining a liquid melamine-formaldehyde resin E having a molar formaldehyde to melamine ratio of 1.7 with a melamine-formaldehyde dispersion D as prepared in Example 3. The solids content of the melamine-formaldehyde resin A was 58%, whereby 55% originated from the liquid melamine-formaldehyde resin E and 3% originated from the melamine-formaldehyde dispersion D. Furthermore, melamine-formaldehyde resin A contained 0.2 wt% of wetting agent Netzmittl PAT959/9 and 0.2 wt.% of a release agent PAT-2523.

A 20 cm x 20 cm piece of a carrier in the form of a Munksjö Décor Paper (80 g/m^2) was impregnated once with the melamine-formaldehyde resin A, then dried for 420 seconds at 100°C. The impregnated paper carrier was then laminated on an MDF board at 100 kN and 190°C for 50 seconds. As the skilled person knows, these conditions are typical conditions for preparing a so-called LPL, i.e. a 'low-pressure' laminate. Surprisingly, the gloss of the laminate as obtained as measured at 20° was 120, about the same as that of a HPL (high-pressure laminate). As the skilled person knows, known LPL's made with once-impregnated carriers have a lower gloss than a HPL, typically 95-100 when measured at 20°.